

Application Serial No. 10/579,087
Reply to office action of November 19, 2008

PATENT
Docket: CU-4808

REMARKS/ARGUMENTS

Reconsideration is respectfully requested.

Claims 1-5 are pending before this amendment. By the present amendment, claims 1-4 are amended. No new matter has been added.

REQUIREMENT FOR INFORMATION

In the office action (page 2, #3 and #4), submission of the following published information is requested by the examiner:

(1 [#3 of OA]) "AT 4022 Noise Master II Reference Manual." In response and (1) pursuant to your request, applicants have filed a copy of the "AT 4022 Noise Master II-Reference Manual." Accordingly, an examiner's acknowledgement of the filed published information by return of the "PTO-1449" form is respectfully requested.

(2 [#4 of OA]) Any publication which any of the applicants authored or coauthored and which describe the disclosed subject matter of the "mean-variance filter" in claim 1 or 3. In response, since "mean-variance filter" is first suggested in a publication of the applicant(s), "Noise-Adaptive Spatio-Temporal Filter for Real-Time Noise Removal in Low Light Level Images", and the present specification, wherein the applicant(s) respectfully disclose to the best of their knowledge that there is no separate document explaining the term "mean-variance filter".

In the office action (page 2, #5), the examiner requests explanation for the slight difference found between the "equation 7" in one reference authored by one of the applicants and one equation in claim 3. In response, the applicants state that although different characters are used to define "equation 7" in the publication of the applicant, "Noise-Adaptive Spatio-Temporal Filter for Real-Time Noise Removal in Low Light Level

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Images" and an equation written in Claim 3, the applicants respectfully disclose that "equation 7" and the equation written in Claim 3 are the same equation.

In the office action (page 4, #8), the specification stands objected to because the title of the invention is not descriptive. In response, the title has been amended as follows:

--DETECTION AND REMOVAL OF NOISE FROM AN IMAGE VIA MEDIAN FILTER AND MEAN-VARIANCE FILTER--.

Withdrawal of the objection to title is respectfully requested.

In the office action (page 4, #9), the disclosure is objected to because of informalities. In response to the examiner's objections, the specification has been amended to correct the typeface and size of text as noted by the Examiner. Therefore, withdrawal of the aforementioned objections is respectfully requested.

In the office action (page 5, #10), claims 2 and 3 stand objected to because of informalities. In response to the examiner's objections, claims 2 and 3 have been amended to correct the typeface and size of text as noted by the Examiner. Therefore, withdrawal of the aforementioned objections is respectfully requested.

In the office action (page 5), claims 1-3 stand rejected under 35 U.S.C. §101 because they do not fall within one of the four statutory categories of invention. In response, the applicants disclose that the method claimed in claim 1 is embodied by a noise removing system. Accordingly, when the noise removing system of the present invention includes a calculation unit, a detecting unit, a first filter, an identifying unit, and a second filter, the calculation unit performs the limitation of claim 1 that recites –

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dividing image data contained in the image into predetermined unit areas and calculating each threshold corresponding to the unit area by using values of pixels contained in the unit area—, the detecting unit performs —detecting whether a first pixel containing impulsive noise exists in the unit area by using the calculated threshold—, the first filter performs —applying a median filter to the first pixel in the case the first pixel is detected—, the identifying unit performs —identifying a second pixel adjacent to the first pixel in the case the median filter is applied to the first pixel—, and the second filter performs --applying a mean-variance filter to the second pixel—. That is, the method of the present invention of claim 1 does not merely enumerate steps.

Accordingly, at least for the above reasons alone, the subject matter as claimed in claims 1-3 are statutory as it recites a limitation that "produces a useful, concrete and tangible result," and, on this ground alone, withdrawal of the rejection is respectfully requested.

In the office action (page 6), claim 4 stands rejected under 35 U.S.C. §101 because the claimed invention is directed to non-statutory subject matter. With regard to claim 15, the examiner asserts claim 15 fails to place the invention squarely within one statutory class of invention because the claimed —computer readable medium— attempts to claims both the physical medium as well as signals. Certain data structures and computer programs are considered to impart functionality when encoded on a computer-readable medium. When such data structures or computer programs are recorded on some computer readable medium, it becomes structurally and functionally interrelated to the medium and will be considered statutory in most cases.

Nevertheless, claim 4 has been amended as follows:

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~~--A computer readable **record** medium **recording a program for implementing medium used in association with a computing device which includes a processor and a memory, the computer readable medium including computer instructions which are configured to cause the computing device to implement** the method according to claim 1 in a computer--.~~

As amended claim 4 clearly defines that the computer readable recording medium includes --computer instructions which are configured to cause the computing device to implement the method--. The computer readable recording medium as claimed in amended claim 4 above does not attempt to include "signals" or "energy" within its definition, as "signals" or "energy" cannot include computer instructions configured to cause the computing device to implement a method. Also, the examiner alleges that because the specification at page 15 line 31 through page 16 line 2 states that a computer readable media may also be a carrier wave and carrier waves per se are considered non-statutory subject matter. Further, applicants believe that claim 4 cannot be considered as a signal or carrier wave since it recites a medium having stored thereon computer executable instructions. A signal, as understood in the art, merely conveys information wherein the signal is the information to be conveyed. Thus, a signal or carrier wave necessarily cannot be considered a medium having instructions stored thereon. Thus, for at least the above reasons, the claim 4 as amended is considered to be in condition for allowance, and an indication thereof is respectfully requested.

In the office action (page 6), claim 5 stands rejected under 35 U.S.C. §101 because the claimed invention is directed to non-statutory subject matter.

Claim 5 is rejected as being directed to non-statutory subject matter for referring

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to "a system" as software per se.

Claimed subject matter is directed to a practical application of a judicial exception (law of nature, abstract idea, naturally occurring article/phenomenon) when it:

- 1) transforms an article or physical object to a different state or thing; or
- 2) otherwise produces a useful, concrete and tangible result.

The applicants recognize that a process that merely manipulates an abstract idea or performs a purely mathematical algorithm is non-statutory although it might inherently have some usefulness. However, claim 5 is **not** directed to mere manipulation of abstract idea or computation of a purely mathematical algorithm. That is, according to the presently claimed invention of claim 5 claim a threshold calculation unit is provide for--dividing image data contained in the image into predetermined unit areas-- and --calculating each threshold corresponding to the unit area by using values of pixels contained in the unit area--; --a first filter **detecting** whether a first pixel containing impulsive noise exists in the unit area by using the **calculated** threshold and **applying** a median filter to the first pixel in the case the first pixel is detected--; and --a second filter **identifying** a second pixel adjacent to the first pixel and **applying** a mean-variance filter to the second pixel--.

The data being manipulated in the presently claimed invention are not in the abstract realm but are the results of the physical transformation of --dividing image data contained in the image into predetermined unit areas-- and --calculating each threshold corresponding to the unit area by using values of pixels contained in the unit area--.

(See *Diamond v. Diehr*, 450 U.S. at 183-84, 209 USPQ at 6, "A [statutory] process ... [includes] an act, or a series of acts, performed upon the subject matter to be

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transformed and reduced to a different state....")

Thus, at least for the above reasons alone, the subject matter as claimed in claim 5 is statutory as it recites a limitation that "1) physically transform or reduce an article to a different state or thing," and, on this ground alone, withdrawal of the rejection is respectfully requested.

In the office action (page 6), claims 1, 2, 4 and 5 stand rejected under 35 U.S.C. §103(a) as being unpatentable over "Impulsive Noise Filtering based on Noise Detection in Corrupted Digital Color Images," Circuits, Systems and Signal Processing, Vol. 20 No. 6, pp. 643-654 (Sohn) and further in view of U.S. Patent No. 5,771,318 (Fang). The "et al." suffix is omitted in a reference name.

The applicants have amended claim 1 to clarify the presently claimed invention and to traverse the examiner's rejection.

The present invention relates to providing a method for removing noise in an image. More particularly, a method for effectively removing impulsive or Poisson noise while in the process of performing spatial filtering on the image and preserves the edge or detailed information of the image, thereby maintaining its resolution. That is, claim 1 includes using a mean-variance filter to remove both an impulsive noise and Poisson noise **simultaneously** while an edge of an image or detailed information is preserved.

To clarify this aspect of the presently claimed invention, claim 1 has been amended to recite inter alia:

--dividing image data contained in the image into predetermined unit areas; and calculating each threshold corresponding to the unit area by using values of pixels contained in the unit area--.

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Neither Sohn nor Fang teaches or suggests the present invention of amended claim 1 whether Sohn or Fang is considered individually or in combination and one skilled in the art would not have been motivated at the time the invention was made to modify the cited references to produce the claimed invention.

The examiner apparently concedes that Sohn does not teach or disclose applying a mean-variance filter to pixels next to the pixel where the medium is applied. To cure this deficiency, the examiner cites to Fang as disclosing the use of a mean-variance filter (OA page 7). The Examiner alleges that it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the technique of Sohn with the technique of Fang, motivated by the need to remove noise from an image while preserving edge regions in the image (Fang, col. 3, lines 1-6) (OA page 7). However the applicants respectfully submit that when the references are viewed for the whole of their teachings, one of ordinary skill in the art would not of been motivated to combine the references. Firstly, Sohn fails to teach or disclose a configuration similar to the mean-variance filter to remove the Poisson noise. Second, one skilled in the art would not have been motivated combine the technique of Sohn in view of technique of Fang and especially for Fang, where Fang fails to teach or suggest the limitation of claim 1 that recites inter alia: --identifying a second pixel adjacent to the first pixel in the case the median filter is applied to the first pixel-- and --applying a mean-variance filter to the second pixel--.

The present invention takes into account specific properties of the noise distribution and these properties have been subsequently used for making the algorithm computationally more efficient and operational in real-time. This proposed algorithm at

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any given time works with a minimum number of unknowns (for example 2-3 unknowns) thereby resulting in faster and more reliable solutions.

In contrast, the mean-variance smoothing approach disclosed in Fang's invention **makes use of seven unknown parameters throughout the whole process** which includes window size, a number of filter directions, an adaptive weighting parameter map means, an adaptive weighting process means, an adaptive combination parameter map means, and a final computation means. Variation of all these parameters through one cycle of image pixels is time-consuming and contradicts the design motive of the filter in the proposed patent.

The table herein under clearly illustrates the differences between the present invention and Fang.

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| Proposed Patent | Fang's Method |
|--|--|
| 1. The proposed patent is intended to be used for low light level images where the main noise sources are Poisson or Photon counting noise and false color noise. Hence, in addition to the data preserving statistical filter the proposed algorithm makes use of contrast, temporal correlation, and segmentation of bright and dark pixels. | 1. Fang's method utilizes the edge preserving smoothing filter where the strength of the filtering is controlled by the data present within a local window. |
| 2. The proposed patent also uses a separate noise detection module which makes use of low light properties to detect the presence of noise in the image. Assumptions are also made that the noises are mostly concentrated in the low light areas with low contrast and exposure. | 2. Fang's method is based on the assumption of uniform noise whose spread function is distributed throughout the images. Thus, based on this assumption, Fangs method processes every pixel in the image as noise pixel. |
| 3. The proposed patent design principles takes into account specific properties of the noise distribution and these properties have been subsequently used for making the algorithm computationally more efficient and operational in real-time. The proposed algorithm at any given time works with a minimum number of unknowns (2-3) thereby resulting in faster and more reliable solutions. | 3. The mean-variance smoothing approach proposed makes use of seven unknown parameters throughout the whole process which includes window size, number of filter directions, an adaptive weighting parameter map means, an adaptive weighting process means, an adaptive combination parameter map means, and a final compute means. Variation of all these parameters through one cycle of image pixels is time-consuming and contradicts the design motive of the mean-variance filter in the proposed patent. |
| 4. Since the proposed patent is designed for real-time use, we also included the possibility of motion pixels being detected as noise pixels between adjacent frames in the statistical domain temporal filtering (STDF) process. | 4. Designed to deal with only static images. |

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Therefore, as shown above, even if one skilled in the art had looked to Fang, it would not have been obvious to modify Sohn using the teachings of Fang for -- identifying a second pixel adjacent to the first pixel in the case the median filter is applied to the first pixel-- and --applying a mean-variance filter to the second pixel--.

Accordingly, applicants submit that independent claim 1, is allowable because the applied references, alone or in combination, fail to teach or suggest all of the required features of the claim 1, which recites inter alia --identifying a second pixel adjacent to the first pixel in the case the median filter is applied to the first pixel-- and --applying a mean-variance filter to the second pixel--, and one of ordinary skill in the art at the time the invention was made would not have been motivated to combine and modify the applied references to produce the claimed invention.

As to dependent claims 2-3, the applicants respectfully submit that these claims are allowable at least since they depend from independent claim 1, which is now considered to be in condition for allowance for the reasons above for claim 1.

In the office action (page 8), claims 4 and 5 stand rejected for the same reasons set forth for the corresponding method of claim 1.

Independent claim 4 of the present invention includes similar limitations to that of claim 1. Therefore, for reasons analogous to those argued above with respect to claim 1, claim 4 is patentable over the applied references.

As to claim 5, the applicants respectfully submit that claim 5 is allowable at least since it depends from claim 4, which is now considered to be in condition for allowance for the reasons mentioned above for claim 1.

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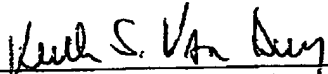
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For the reasons set forth above, the applicants respectfully submit that claims 1-5, now pending in this application, are in condition for allowance over the cited references. Accordingly, the applicants respectfully request reconsideration and withdrawal of the outstanding rejections and earnestly solicit an indication of allowable subject matter.

This amendment is considered to be responsive to all points raised in the office action. Should the examiner have any remaining questions or concerns, the examiner is encouraged to contact the undersigned attorney by telephone to expeditiously resolve such concerns.

Respectfully submitted,

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Keith S. Van Duyne, Reg. No. 54,505
Ladas & Parry LLP
224 South Michigan Avenue
Chicago, Illinois 60604
(312) 427-1300